is offered. Briefly stated, the essential idea is that, just as in a highly cooled vessel of salt water the ice crystallizes at the sides, bottom and top, leaving a core of more concentrated liquid at the center, so here the solvent may have frozen out, collecting at the borders of the cavity in a more or less pure condition, as foyaite, and gradually becoming more basic (richer in the solute) as the freezing process crept towards the center.

Although the great work of the Russian petrographer, F. Loewinson-Lessing, on the Eruptive Rocks of the Central Caucausus, was issued more than two years ago, the views advanced are only beginning to get into form accessible to the majority of English students. The general interest lies in the discussions of the subjects of rock-classification and the differentiation of rock magmas.

The classification proposed for the igneous rocks is chemical. It is based primarily upon the degree of acidity of the silicate minerals. Four great groups are thus established: (1) The ultra-basic rocks, derived from a monosilicate magma, (2) basic rocks, which had a bisilicate magma, (3) neutral rocks, with a magma which was bisilicate or normal, and (4) acid rocks, in which the magma was polysilicate. These groups are subdivided in 14 sub-groups and 34 families.

In order to find the proper systematic position of an eruptive rock from the fundamental viewpoint of the proposed classification four factors are considered: (1) The relation of the oxygen in the silica and that in all the other oxides taken together, giving what is termed the coefficient of acidity; (2) the chemical composition, which gives for each type a distinctive formula; (3) the relations between the two groups of oxides according to their molecular proportions; and (4) the relations of the soda and potash in the alkaline rocks. This consideration of the principles of classification leads to the proof of the distinct phases of fundamental magmas.

Discussion of the differentiation of rock magmas has an unusual interest. The Russian author calls special attention to the principle of Soret, the action of super-saturated solutions, the effect of gravity, the principles of maximum work as proposed by Berthelot, and the reaction of mixed liquids, as operating in the separation of magmas.

Three distinct kinds of magmatic differentiation are recognized. They are: Static differentiation, taking place in the depths of the earth; differentiation by cooling during ascent to the surface; and crystalline differentiation. Specific gravity, pressure and temperature are the chief factors governing the course of the static kind; while chemical affinities come into play in large measure only in crystalline separation.

The rôle of inclusions of foreign rocks, which has so long been such an unsatisfactory subject to petrographers, is explained on the idea that it is only that portion of the magma yet undifferentiated which affects the introduced rocks. After thorough assimilation of limestone, for example, a separation of the modified magma takes place. One part contains very little lime and the other nearly all of it. Rock formed from the first mentioned might be a granite, while from the second would come perhaps a gabbro.

CHARLES R. KEYES.

ON THE REASON FOR THE RETENTION OF SALTS NEAR THE SURFACE OF SOILS.

VERY recently a light-colored saline incrustation was noticed by Professor Milton Whitney upon the surface of the soil in the grounds of the Department of Agriculture in Washington. This crust was collected and examined in the laboratory of the Bureau of the Soils under the direction of Dr. Frank K. Cameron. The crust contained about 1 per cent. of soluble matter, principally sulphates and nitrates of sodium and calcium. Samples were then collected at different depths and examined to determine the vertical distribution of the soluble salts. The results showed that although the soil was examined to a depth of three feet, practically all of the salt was in the surface inch, the larger part of it being in the top eighth-inch.

The crust was found at the end of a short, dry season, such as is common in the autumn months along the Atlantic coast region.

A number of similar occurrences of abnormal amounts of soluble matter on the sur-

face of the soils of humid regions have been reported, but very little has been written about them. Cameron has, in Bulletin No. 17, Division of Soils, described a number of occurrences of crusts in humid regions, and has called my attention to several others which were not known to him at the time his paper was published. All of these cases were after a short season of dry weather, but it must be admitted that their occurrence seems rather an anomaly when the heavy rainfall is considered. For what is the reason that this salt remains near the surface of the ground when the water from the rains passes down through the soil? If the salt which is soluble in water is dissolved by the downward percolating rains, why is it not continually washed deeper into the subsoil? Why is it that, in spite of the fact that more water passes downward than returns to the surface by evaporation and capillary movements upward, analyses of soils in the humid regions invariably show more soluble matter in the surface soil than in the subsoil?

There are several reasons which may account for this seemingly anomalous condition of affairs. First, in the soils of the humid region the great bulk of the decomposition of the soil minerals and the consequent liberation of soluble matter takes place within the soil proper in which the greatest aeration takes place, where the bacteria are most numerous and where tillage and sunlight and changes of temperature have a maximum influence.

A second reason which might be given is that of absorption. Very little definitely is known about the phenomenon called absorption, beyond the fact that it is a property of soil grains or of any surface by virtue of which matters in solution are held so that is difficult to wash them off, so that salts which are liberated during the processes of weathering are held near the surface by the absorption.

There is a third factor which seems to assist in accounting for the salts at the surface, and that is that there is a difference between the rates of downward and upward movements of salts within the soil.

When water falls on the soil both gravity and capillary attraction act in the downward movement. Capillary attraction is more effective in the smaller spaces between the soil grains, while gravity is more effective in the larger openings. When water leaches through a soil in a field, by far the larger part of it passes through the larger openings—those produced by insects, worm burrows, root holes, cracks, large interstitial spaces formed by coarse grains, etc. That such is the case is very easily proven if the rate of percolation is measured through a block of soil in field condition, and the same block is broken up dry, so as to prevent puddling and the rate of percolation is measured again. A simple examination of any soil in the field will reveal the presence of these larger openings, and as the resistance to flow varies as the fourth power of the diameter of the tube, a much larger amount of water passes downward through the large openings, than passes through the smaller true capillary spaces. These larger openings might well be called the gravitational spaces, and the smaller spaces in the soil grains the capillary spaces.

When water moves upward through a soil to replace that lost by evaporation or removed by plants, the movement is entirely capillary and the entire film around the soil grains moves.

Now let us consider the action which takes place when rain falls upon a soil covered with a thin soluble crust. First of all the soluble matter is dissolved and carried down into the soil. The downward-moving wave penetrates most rapidly along the gravitational spaces, since here the resistance is least and the front of the wave is drawn laterally into the true capillary spaces by surface tension. These capillary spaces, therefore, largely fill with water from the front of the wave, and since the front of the wave contains the greater part of the salt dissolved, this salt is thus retained in the capillary spaces. As soon as the capillary spaces are filled, practically all movement in them ceases, except the slow downward percolation caused by gravity, and in a soil of average texture this movement is practically nothing. The movement in the gravitational spaces continues. The salt in the water which was drawn back from the front of the penetrating wave remains stationary or only

escapes out into the gravitational spaces by diffusion.

When the rain ceases the gravitational spaces drain of water, carrying off relatively a small part of the soluble matter, and the evaporation from the surface causes the upward movement to commence, but this movement is entirely capillary and the whole film around the soil grains moves, and as it moves so does all of the salt except possibly that portion absorbed, and there is evidence which leads one to believe that the absorbed salt moves also, but rather more slowly than the film; that is, the absorbed salt shows a tendency to lag behind.

Therefore, it will be seen that the rains do not move the salt as far down as they penetrate but leave the most of it near the surface of the soil or at least so close to the surface that capillary movements will again accumulate at the surface as soon as the dry season occurs.

This explanation of the movement of soluble salts within a soil finds application in a number of ways. In the arid regions, where the soluble salts are more abundant than in the humid climate, and where the movements of these salts, if not understood and controlled, ofttimes result in the accumulation of soluble matter this explanation of the difference in the rate of downward movement, compared with the upward movement, goes far to explain some points which were heretofore but imperfectly understood. For example, it has always been difficult for the writer to understand why alkali salts should continue to accumulate at the surface of the ground in spite of the repeated irrigations, and the maxim laid down by agriculturists in that region that 'alkali goes with the water.' In one district of especial notoriety in California the water table was thirty years ago about sixty feet below the surface of the ground and there were no indications of alkali. Irrigation was commenced and continued large and excessive quantities were used. All of the time the water table was steadily rising, showing unquestionably that more water went downward through the soil than came up for evaporation, and yet in spite of this accumulative downward movement of the water the alkali salts, which, so far as can be gathered from adjacent unirrigated areas, was within the surface twenty feet of the soil, have been steadily creeping upward and at the present time fully ten per cent. of the area is suffering from an excess of alkali salts.

It is plain that if we desire to send the salts downward the easiest way to do it is to make the downward movement, as far as possible, capillary instead of gravitational. One way of doing this is to break up the soil gravitational spaces by deep cultivation and subsequent firming by flooding. Such has been found very effective in certain areas of Arizona. Another way is to flood the soil with frequent shallow irrigations. In this way a slow downward capillary current is kept up. Half a dozen floodings with one inch of water each will be found to carry downward much more salt than one flooding of six inches.

Another lesson taught, one well known for many years, is that if the subsurface water is alkaline it must not be allowed to rise so close to the surface that continuous upward capillary movement is possible; else the alkali will accumulate in the soil, to its detriment.

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CHEMISTRY IN THE CALIFORNIA SCHOOLS.

THE chemistry teachers of the Pacific coast have organized an association to encourage the teaching of chemistry, to harmonize methods, to become acquainted with each other and with the needs of the country and the conditions affecting their profession; and, generally, for all those purposes for which association is good. The organization was effected last August, during the Summer School session of the University of California, at which many teachers from California and from the neighboring States were present. The headquarters of the organization are at Berkeley, which, as it is the educational center of the western part of the country, is the natural location for such a purpose. Two members of the faculty of the University of California, one in the department of chemistry and one in the department of physics, were among the organizers.

The need for such an organization is shown